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A
NEW SYSTEM
OF
ASTRONOMY,
IN
QUESTION AND ANSWER.

FOR THE USE OF
SCHOOLS AND ACADEMIES

BY ALVA CLARK, A. B.

NEW YORK :
ROE LOCKWOOD & SON,
SCHOOL BOOK DEPOSITORY, 411 BROADWAY.



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S. W. Benedict, Printer ,

1843.

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SOUTHERN DISTRICT OF NEW YORK, ss.

BE IT REMEMBERED, that on the 8th day of March, in the forty-fourth year of the Independence of the United States of America, *Alvah Clark*, of the said District, has deposited in this office the title of a Book, the right whereof he claims as Author and Proprietor, in the words following, to wit:

"A New System of Astronomy, in Question and Answer, for the Use of Schools and Academies. By Alvah Clark, A. B."

In conformity to the act of Congress of the United States, entitled, "An Act for the encouragement of Learning, by securing the copies of Maps, Charts, and Books, to the authors and proprietors of such copies, during the times therein mentioned." And also to an Act, entitled, "An Act, supplementary to an Act, entitled an Act for the encouragement of Learning, by securing the copies of Maps, Charts, and Books, to the authors and proprietors of such copies, during the times therein mentioned, and extending the benefits thereof to the arts of designing, engraving and etching historical and other prints."

GILBERT LIVINGSTON THOMPSON,
Clerk of the Southern District of New York

ALV CLARK
D. of C. 1814. 1815.
MAR 11 1814

PREFACE.

THE following system of Astronomy was written some time since, for the use of those by whom I was employed as private instructor, and for the use of Miss Desabye's Boarding School, in which I am engaged to superintend the English department. Knowing, therefore, from experience, that their acquisition of the knowledge of the elements of Astronomy has been facilitated by this work, more than by any other which I could place before them, I am induced to publish it, believing that, while it relieved me from the laborious duty of copying it for every student, it would serve to introduce into our Schools and Academies, the study of this useful and important science.

The study of Astronomy has been too much neglected in the system of education. This has probably arisen from the want of some astronomical work, which could be introduced into schools at a small expense and which would render this science intelligible to youth. These objects, it is believed, will be effected by the following work, which is now published for the use of those who find it necessary to complete their education at Schools and Academies without enjoying the advantages of a liberal education at college, where the science of Astronomy would be embraced in their course of studies.

When I have conversed with teachers on the propriety of making Astronomy a branch of elementary education, they have observed that the usual works on that science were too expensive, and were likewise accompanied by many geometrical and algebraical explanations, which the young student could not comprehend, and of which a knowledge could not be acquired in the short period allotted to elementary education. This objection, supported by fact, has influenced me to avoid, in the definitions and explanations, too frequent use of technical terms, and to omit some things which are not practically useful, and can be understood by those only who are acquainted with the higher branches of geometry and mathematics.

To obtain an accurate knowledge of the following work, it will be necessary for the teacher to require the student to explain, as far as possible, every definition and problem upon the globes. No impressions are so clear and impressive as those presented to the eye. The reasons for this I need not now enumerate. Experience, the infallible test of every theory, fully confirms this assertion.

Though the general importance and utility of the study of Astronomy has never been denied, yet I have often heard it observed, that it is entirely useless in the system of female education. All the reasons which can be given in support of this position are equally forcible against the benefit of any science to the female mind. The science of Astronomy explains and illustrates the phenomena of the natural world, and exhibits, in the system of the universe, that harmony and

order, which bespeak the creative power and wisdom of the Deity. It enlarges the faculties, and strengthens the energies of the mind. If such a study must be rejected from the system of female education, where, I ask, will retrenchment end?

If the objection arise from the opinion, that the female mind is not competent to the investigation of the Elements of Astronomy, I leave it to the contempt it so justly deserves, only asking the objector on what authority he attributes to the female sex, that inferiority of intellect which his objection supposes?

I have for some time past, been exclusively engaged in the business of instruction: and my own experience, and the opinion of those teachers in whom I place the highest confidence, have convinced me, that the method of instruction by "question and answer," is, in many branches of education, highly beneficial; provided the questions are so constructed, that the answers to them will necessarily involve all the important principles of the science to which they are adapted.

When the lesson in this form is placed before students, they know what will be required of them in the recitation, and are sure that nothing, which will be required, has escaped their attention. Such a course of study inspires them with confidence, and dissipates that uncertainty, which perplexes and confuses the mind, and destroys all that pleasure which is to be derived from the pursuit of literature.

These views have influenced me to adopt, as far as possible, the catechetical mode of instruction. I shall be cautious not to carry it too far; but to adopt it to that extent, which, while it diminishes the labour of the teacher, will promote the assiduity, advancement, and satisfaction of the student.

That teachers and the public concur with me in this respect, I have sufficient evidence, in the unexpected and rapid sale of a work which I lately published, entitled, "Questions adapted to the study of Tytler's Elements of History." And in the approbation given to a similar work, entitled, "Questions to Blair's Rhetoric," published by A. Bixby, principal of John-street School.

Should the encouragement given to those works be extended to this, I shall publish some others, calculated to introduce into the schools of this country, some salutary branches of literature, which have been hitherto excluded from the attention of youth either by extending the volumes which contain them, to an unnecessary expense, or by treating of them in a manner not suited to the general use of schools and academies.

I confidently trust, that the experience of other teachers will convince them of the utility of this method of instruction; since it is one, which makes their own duties less laborious, and consults the welfare of students, by making them confident of their ability to acquire a knowledge of those sciences, whose obscurity, or difficulty, has hitherto checked their progress, and discouraged their application.

New-York, March 16th, 1820.

ASTRONOMY.

PART I.

SECTION I.

Definitions.

What is ASTRONOMY?

It is the science which treats of the heavenly bodies.

What do we learn by it?

We learn the figure, dimensions, motion, and relative distances of the heavenly bodies.

What is an *Angle*?

It is the space contained between two lines meeting at a point.

What is a *Right Angle*?

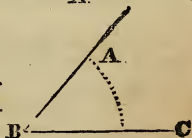
It is an angle formed by one line falling perpendicularly upon another, thus :

A B C is a right angle, or contains ninety degrees.



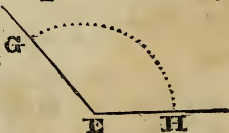
What is an *Acute Angle*?

It is less than a right angle, or contains less than ninety degrees.



What is an *Obtuse Angle*?

It is greater than a right angle, or contains more than ninety degrees.



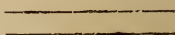
What is a *Triangle*?

It is a figure bounded by three sides.



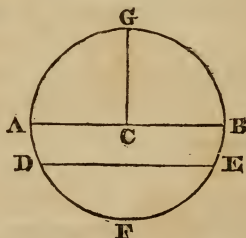
What are *Parallel Lines*?

Those which never approach each other.



What is a *Circle*?

It is a plain figure bounded by a curve line, every part of which is equally distant from a point called the centre.



1. The *Circumference* is the curve line that bounds it.

2. The *Radius* is a straight line drawn from the centre to the circumference, as AC or CB—all radii are equal.

3. The *Diameter* is a line drawn through the centre, terminated both ways by the circumference, as AB.

4. An *Arc* is any part of the circumference, as DF.

5. The circumference is divided into 360 degrees; each degree into 60 minutes, and each minute into 60 seconds.

What is a *Sphere*?

A sphere is properly a globe; but in Astronomy, the celestial sphere means the apparently concave orb of the heavens, in which all the heavenly bodies appear to be placed.

What is the *Axis* of a heavenly body?

It is an imaginary line, round which it performs its daily motion.

To what is it equal?

It is equal to a diameter.

What is the *Axis* of the *Artificial Globe*?

It is a line which passes through its centre from one pole to the other.

What are the *Poles* of a *Great Circle*?

They are two points equally distant from every part of its circumference.

What are the *Poles of the Earth*?

They are the extremities of the axis; and are called the north or arctic pole, and the south or antarctic pole.

What are the *Celestial Poles*?

They are the extremities of the earth's axis produced to the heavens.

What is the *Diameter* of a sphere?

It is a straight line which passes through the centre, and is terminated both ways by the surface of the sphere.

What is the *Circumference* of the sphere?

It is any great circle drawn on its surface.

How are the circles of the sphere divided?

In two kinds—*Great and Small*.

What is a *Great Circle*?

It is that whose plane divides the sphere into two equal parts, called hemispheres.

What is a *Hemisphere*?

It is half a globe.

How many hemispheres are there?

The number is infinite, as any great circle divides

the globe into two hemispheres. Those most frequently used are six :

1. The *Northern and Southern*, formed by the equator.
2. The *Eastern and Western*, formed by a meridian.
3. The *Upper and Lower*, formed by the rational horizon.

Mention the principal great circles.

There are four : *Equator, Ecliptic, Meridian, and Horizon.*

Can two great circles be parallel ? No.

What is a *Small Circle* ?

It is that whose plane divides the globe into two unequal parts.

Mention the principal small circles.

They are four : the two *Tropics* and two *Polar Circles.*

What are the *Parallels of Latitude*

They are all those small circles parallel to the equator.

Are all small circles parallel to the equator ?

They may be parallel to the ecliptic, horizon, meridian, or any other great circle.

What are parallels of latitude on the celestial globe ?

They are small circles parallel to the ecliptic ?

What are *Parallels of Declination* ?

They are small circles parallel to the equator, and are the same as parallels of latitude on the earth.

What are *Parallels of Altitude* ?

They are small circles parallel to the horizon.

What are *Concentric Circles* ?

They are circles drawn round the same centre.

What are *Cardinal Points* ?

They are certain fixed points that never change, and to which all calculations are referred.



SECTION II.

Of the Equator.

What is the *Equator*?

It is a great circle whose plane divides the earth into northern and southern hemispheres.

How far distant is it from the poles?

Every part of it is ninety degrees distant.

What is it called when referred to the heavens?

The *Equinoctial*.

What is it called by mariners?

The *Line*.

What are reckoned on it?

Longitude, right ascension, &c.

SECTION III.

Of the Meridian.

What are *Meridians*?

They are great circles, whose planes divide the globe into eastern and western hemispheres.

What is their direction?

They all pass through the poles, and cut the equator at right angles.

How many meridians are there?

Their number is unlimited; there may be as many as there can be taken points on the equator

Why are they called *Hour Circles*?

Because as they are drawn on most globes, the sun passes from one to another of them every hour?

What supplies their places as hour circles?

The hour circle and its index.

What is the *Hour Circle*?

It is a small circle of brass fixed to the north pole, with the hours of the day marked on it.

What is the *First Meridian*?

It is that from which geographers begin to count the longitude.

What first meridian is most frequently used?

The meridian of London.

What is the *Brazen Meridian*?

It is that in which the artificial globe turns.

How are the degrees numbered on it?

On the upper semicircle from the equator towards the poles—on the lower semicircle from the poles to the equator.

What is *Longitude*?

It is distance east or west from the first meridian reckoned on the equator.

What is the greatest longitude a place can have?

One hundred and eighty degrees either east or west from the meridian.

What is *Latitude*?

It is distance either north or south from the equator, reckoned on a meridian.

What is the *Greatest Latitude* a place can have?

Ninety degrees either way from the equator.

What is *Declination* on the celestial globe?

It is the distance north or south from the equinoctial, and corresponds to latitude on the earth.

How is latitude reckoned on the celestial globe?

Ninety degrees each way from the ecliptic.

What is longitude in the heavens?

It is distance on the ecliptic, reckoned eastward from the first degree of the sign Aries.

What is the greatest longitude of a heavenly body?

Three hundred and sixty degrees, beginning at the first degree of Aries, and reckoning on the ecliptic eastward quite round the globe.

What is the greatest latitude of the sun, a planet and star.

1. The sun being always in the ecliptic, has no latitude.

2. A planet can have only eight degrees of latitude, because it never leaves the zodiac, which is eight degrees wide on each side of the ecliptic.

3. A star may have ninety degrees of latitude.

What is the greatest declination of the sun, a planet, or star?

1. The greatest declination of the sun is about twenty-three degrees and a half.

2. That of a planet about thirty-one degrees and a half to the limit of the zodiac.

3. That of a star 90 degrees.

What are the *Geocentric* latitudes and longitudes of the planets?

Their latitudes and longitudes as seen from the earth.

What are their *Heliocentric* latitudes and longitudes?

Their latitudes and longitudes as seen from the sun.

What is the *Right Ascension* of a heavenly body?

It is that degree of the equinoctial, which rises with the body in a right sphere; and is reckoned from the first degree of Aries eastward round the globe.

What is *Oblique Ascension*?

It is that degree of the equinoctial, which rises with the body in an oblique sphere, and is reckoned in the same way.

What is *Oblique Descension*?

It is that degree of the equinoctial which sets with the body in an oblique sphere.

How many positions has the sphere?

Three; *Right, Oblique, and Parallel.*

What is a *Right Sphere*?

It is that in which all the circles of daily motion rise directly above and descend directly below the horizon.

How is it represented?

By placing both poles in the horizon

What is an *Oblique Sphere*?

It is that in which all the circles of daily motion are oblique to the horizon.

How is it represented?

By raising one pole a little, and depressing the other.

What is a *Parallel Sphere*?

It is that in which the equator coincides with the horizon, and all the circles of daily motion are parallel to the horizon.

How is it represented?

By elevating one pole to the zenith, and depressing the other to the nadir.

What places have each of these spheres?

Those directly under the equator have a right sphere, those between the equator and poles have an oblique sphere, and those directly under the poles have a parallel sphere.

SECTION IV.

Of the Ecliptic

What is the *Ecliptic*?

It is a great circle which intersects the equinoctial at an angle of about twenty-three degrees and a half.

Of what is it the path?

It is the orbit in which the earth revolves round the sun once a year.

What are the *Equinoctial Points*?

They are the points where the ecliptic and equinoctial intersect each other.

When does the sun pass these points

It passes Aries twenty-first of March, called the

vernal equinox, and Libra twenty-third of September, called the autumnal equinox.

When are the day and night every where equal?

When the sun is in the equinoxes.

What are the *Solstitial Points*?

They are the points of the ecliptic farthest from the equinoctial, or where it touches the tropics.

How far from the equinoctial to the solstitial points?

Ninety degrees, or a quarter of a circle.

When is the sun in the solstitial points?

On the twenty-first of June, called the summer solstice, and on the twenty-second of December, called the winter solstice.

What are their signs?

Cancer is the northern or summer solstice.

Capricorn the southern or winter solstice.

What is said of the day and night when the sun is in these signs?

1. When the sun enters Cancer, *all* places in the northern hemisphere have their longest day, and those in the southern their shortest day.

2. When the sun enters Capricorn, *all* places in the southern hemisphere have their longest day, and those in the northern their shortest day.

3. When the sun enters Cancer, *all* places within the north polar circle have constant day, and *all* places within the southern constant night.

4. When the sun enters Capricorn, *all* places within the south polar circle have constant day, and all those within the northern constant night. The last two appearances continue for a short time only; but it is to be observed,

5. That some places within the south polar circle, have continual night during the whole six months the sun is north of the equinoctial, and *some* places within the north polar circle have at the same time perpetual day; and,

6. That during the six months the sun is south of the equinoctial, *some* places within the south polar circle have continual day, and some within the northern continual night.

NOTE. These six statements may be explained upon the globe. (See part 3, Problem 18.)

What is the *Equinoctial Colure*?

It is that meridian which passes through the *equinoctial* points.

What is the *Solstitial Colure*?

It is that meridian which passes through the *solstitial* points.

How is the ecliptic divided?

Into *Twelve Signs*, each containing thirty-degrees.

Mention the names of the signs, and the day on which the sun enters them.

♈ Aries twenty-first of March.	}	Spring signs.
♉ Taurus twentieth of April.		
♊ Gemini twenty-first of May.		
♋ Cancer twenty-first of June.	}	Summer signs.
♌ Leo twenty-third of July.		
♍ Virgo twenty-third of August.		
♎ Libra twenty-third of Sept.	}	Autumnal signs.
♏ Scorpio twenty-third of Oct.		
♐ Sagittarius twenty-third Nov.		
♑ Capricornus twenty-second Dec.	}	Winter signs.
♒ Aquarius twentieth January.		
♓ Pisces eighteenth February.		

What are the cardinal points of the ecliptic?

They are the equinoctial and solstitial points.

What is the *Zodiac*?

It is a space sixteen degrees wide, extending eight degrees on each side of the ecliptic; and contains the orbits of the planets.

What is the *Orbit* of a planet?

It is the path in which it revolves round the sun.

What is the *Figure* of these orbits?

Elliptical, or longer one way than the other.

How do the planets revolve in them?

From west to east round the sun.

What are the *Apparent Motions* of the planets?

Three; *Direct*, *Stationary*, and *Retrograde*.

1. A planet's motion is said to be *Direct*, when to a spectator on the earth, it appears to move forward in its orbit from west to east.

2. It is said to be *Stationary*, when it appears for some time in the same point of the heavens.

3. It is said to be *Retrograde*, when it appears to move backward in its orbit, from east to west, contrary to the order of the signs.

What are the *Nodes*?

They are the two opposite points, where the orbit of the planet intersects the ecliptic.

What is *Aspect*?

Aspect of the stars or planets is their situation and relative distances with respect to the sun and each other.

What is the *Aphelion*?

It is that point of the orbit farthest from the sun.

What is *Perihelion*?

It is that point of the orbit nearest the sun.

What is *Elongation*?

It is the apparent distance of any body from the sun.

What is *Apogee*?

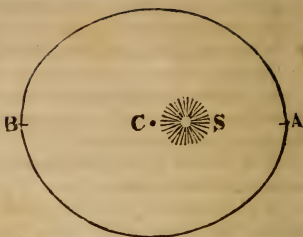
It is that point in the orbit of the moon or any planet farthest from the earth.

What is *Perigee*?

It is that point in the orbit of the moon or planet nearest the earth.

The *Apsis Line* is that which joins the aphelion and perihelion, or which joins the apogee and perigee. These definitions are thus explained:

Let S be the Sun and C the centre of the orbit; then A, the point nearest the Sun, is the perihelion; and B, the point farthest from the sun, is the aphelion. As the sun is not exactly in the centre of the orbit,



the distance from C, the centre of the orbit, to the centre of the sun, is called the *Eccentricity*

How do the planets move in their orbits?

Variably; sometimes faster and sometimes slower.

What is the *Mean* place of a planet?

It is the place where it would be if it moved in its orbit with equal velocity at all times.

What is the *True* place?

It is the place where it really is.

SECTION V.

Of the Horizon.

What is the *Horizon*?

It is the circle which separates the visible part of the heavens from the invisible.

How many horizons are there?

Two; *Sensible* and *Rational*.

What is the *Sensible Horizon*?

The sensible or apparent Horizon is that circle which bounds our prospect where the earth and sky appear to meet.

What is the *Rational Horizon*?

It is a great circle whose plane is parallel to the

plane of the visible horizon, and divides the earth into upper and lower hemispheres.

What is the *Wooden Horizon*?

It is that circular plane circumscribing the artificial globe, which represents the rational horizon.

What are the cardinal points of the horizon?

They are east, west, north, and south.

What are the cardinal points in the heavens?

The *Zenith* and *Nadir*.

What are the *Poles* of the horizon?

The *Zenith* and *Nadir*.

What is the *Zenith*?

It is the point in the heavens exactly over our heads.

What is the *Nadir*?

It is the point in the heavens opposite to the zenith, or directly under our feet.

What is the *Mariner's Compass*?

It is a representation of the horizon, and is divided into 32 equal parts.

What is the *variation of the compass*?

It is the deviation of the north and south points of the magnetic needle, from the north and south points of the horizon, either east or west.

What is an *Azimuth* or *Vertical Circle*?

It is a circle passing through the zenith and nadir, cutting the horizon at right angles.

What is the *Azimuth* of an object in the heavens?

It is that part of the horizon contained between a vertical circle passing through the body, and the north or south points of the horizon.

What is a *Prime Vertical*?

It is that azimuth circle which passes through the east and west points of the horizon.

What is the *Altitude* of a heavenly object?

It is the distance from the object to the horizon, reckoned on a vertical circle.

What is the *Zenith Distance* of a heavenly body?

It is the distance from the body to the zenith, reckoned on a vertical circle.

What is the *Polar Distance* of an object?

It is its distance from the pole, reckoned on a meridian.

What is the *Amplitude of a heavenly body*?

It is the distance which it rises from the east, or sets from the west point of the horizon.

What is *Twilight*?

It is that faint light, which appears before the sun rises and after it sets.

What is the *Diurnal Arch*?

It is the course described by any body from its rising to its setting.

What is the *Nocturnal Arch*?

It is the course described by any body from its setting till it rises again above the horizon.

SECTION VI.

Of the Tropics.

What are the *Tropics*?

They are two small circles parallel to the equator, at about twenty-three degrees and a half from it.

Through what points do they pass?

Through the solstitial points.

What are they called?

The northern is called the *Tropic of Cancer*.

The southern, the *Tropic of Capricorn*.

What do they limit?

They limit the sun's declination, because when it arrives at one of them it turns towards the other.

When does a place have a vertical sun?

When the sun is directly over that place.

What places have a vertical sun?

Those only which are within the tropics; and those have a vertical sun twice every year.

SECTION VII.

Of the Polar Circles.

What are the *Polar Circles*?

They are two small circles described round the poles at the distance of about twenty-three degrees and a half from the poles, and parallel to the equator.

What is their diameter?

About 47 degrees.

What are they called?

The one described round the north pole is called the northern or arctic circle; the other the southern or antarctic circle.

How far are they distant from each other, from the equator, and from the tropics?

1. From each other 133 degrees.
 2. From the equator $66\frac{1}{2}$ degrees.
 3. From the tropics 43 degrees.
-

SECTION VIII.

Of the Zones.

What is a *Zone*?

It is a portion of the surface of the earth contained within the polar circles, or between two small circles parallel to the equator.

How many zones are there?

There are *five*, one *Torrid*, two *Temperate*, and two *Frigid Zones*.

What is the *Torrid Zone* ?

It is the space included between the two tropics, and the equator passes through the middle of it.

How wide is it ?

About 47 degrees, or $23\frac{1}{2}$ degrees each side of the equator.

What are the principal countries in the torrid zone ?

The southern part of North America, the northern half of South America, the West India Islands, the East India Islands, a great part of Africa, the southern parts of Arabia, Hindostan, and China, and the northern part of New Holland.

How many *Temperate Zones* are there ?

Two ; *Northern and Southern*.

Describe the north temperate zone ?

It is that space included between the northern tropic and north polar circle.

How wide is it ?

About 43 degrees.

What are the principal countries in it ?

The United States, East and West Florida, New Mexico, most of the British possessions in North America, the north part of Africa, nearly all of Europe, Persia, and a great part of China, and Russia in Asia.

Describe the southern temperate zone.

It is that space included between the southern tropic and south polar circle.

How wide is it ?

About 43 degrees.

What are the principal countries in it ?

New-Zealand, the southern part of South America, the Cape of Good Hope, and southern part of New Holland.

Describe the *North Frigid Zone*.

It is that space included within the north polar circle, having the north pole for its centre.

How wide is it ?

About 47 degrees.

What countries are in it ?

Spitzbergen, and the northern extremities of North America, Europe, and Asia.

What is said of its day and night ?

The places directly under the poles have continual day for six months, while the sun is north of the equator, and continual night for the six months it is south of the equator. And all the places in this zone have their day longer or shorter according as they are near to, or distant from the pole.

What is the *South Frigid Zone* ?

It is that space included in the south polar circle.

How wide is it ?

About 47 degrees

What is said of its day and night ?

They are the same as in the north frigid zone, only it is night when the sun is north of the equator, and day when it is south of the equator.

What are the *Amphiscii* ?

They are the inhabitants of the torrid zone, so called because they cast their shadows both north and south at different times of the year.

What are the *Heteroscii* ?

It is a name given to the inhabitants of the temperate zones, because at noon they cast their shadows only one way during the year.

What are the *Periscii* ?

It is a name given to the inhabitants of the frigid zones, because during one revolution of the earth on its axis, their shadows are directed to every point of the compass.

What are the *Antæci* ?

They are those who live under the same meridian, and have equal degrees of latitude ; but one has north latitude, and the other south latitude ; but when it is winter with one, it is summer with the other.

What are the *Periæci* ?

They are those who live in the same latitude, but in opposite longitudes ; when it is noon with one, it is midnight with the other.

What are the *Antipodes* ?

They are those inhabitants of the earth who live diametrically opposite to each other, so that the feet of one point towards the feet of the other.—Their latitudes, longitudes, seasons of the year, days and nights, are all contrary to each other.

What is a *Climate* ?

It is a part of the surface of the earth contained between two parallels of latitude ; it diminishes in breadth towards the polar circles.

Why have places in the same climate different temperatures ?

These differences are produced by the influence of woods, lakes, mountains, sandy deserts, &c. upon the atmosphere.

PART II.

THE SOLAR SYSTEM.

SECTION I.

What is a *System* ?

It is a supposed arrangement of the heavenly bodies.

What is a *Solar System* ?

It is that arrangement of the heavenly bodies, which places the sun in the centre, and the other bodies revolving round it.

How many systems have there been, which are much known ?

Three—the *Ptolemaic*, *Tychonic*, and *Copernican*.

Describe the *Ptolemaic* ?

The system was supported by Ptolemy ; he supposed the earth to be placed in the centre of the system, and all the heavenly bodies to revolve round it from east to west.

How many revolutions did he suppose the heavenly bodies to have ?

Two—their daily revolution from east to west ; and another annual revolution round the earth.

Describe the *Tychonic*.

Tycho supposed with Ptolemy that all the heavenly bodies had a diurnal and annual revolution round the earth.

How did he improve the system of Ptolemy ?

By supposing likewise that all the planets, except the earth, revolved round the sun.

What is the *Copernican System* ?

It is the system supported by Copernicus, and is the true solar system.

What does it suppose ?

It supposes the sun to be placed in the centre of the system, and all the planets to revolve around it.

How does it account for the *apparent revolution* of the heavenly bodies round the earth ?

By supposing a real rotation of the earth on its axis from west to east.

What is *Diurnal Revolution* ?

It is the revolution of a body on its axis, and is called its day.

What is *Annual Revolution* ?

It is the revolution of a body in its orbit round the sun, and is called its year.

What is the *Disc* of the sun or a planet ?

It is the circular illuminated surface which we see.

What is a *Digit* ?

It is a twelfth part of the apparent diameter of the disc.

What is *Quadrature* ?

A body is in quadrature with the sun, when the sun and body are ninety degrees distant from each other.

What is *Opposition* ?

A body is in opposition with the sun, when the sun and body are on opposite sides of the earth.

How many kinds of *Conjunctions* are there ?

Two—*Inferior* and *Superior*.

What is *Inferior Conjunction* ?

It is when the body is between the earth and the sun.

What is *Superior Conjunction* ?

It is when the body and earth are on opposite sides of the sun.

What is the *Occultation* of a star or planet ?

It is when they are hidden from the sight by the interposition of the moon or some other planet.

What is *Centripetal* force ?

It is that force which urges a body towards the centre or body round which it is revolving.

What is *Centrifugal Force*?

It is that force with which a body endeavours to recede from the centre or body round which it is revolving.

How are the heavenly bodies divided?

Into *two* kinds—*Luminous* and *Opaque*.

What is a *Luminous Body*?

It is a body which shines by its own light. The sun, and perhaps the fixed stars, are luminous bodies.

What is an *Opaque Body*?

It is that which shines by reflected light, or light received from the sun.

What is a *Planet*?

It is an opaque body which revolves round the sun.

How are the planets divided?

Into two kinds—*Primary*, and *Secondary*, or *Satellites*.

What is a *Primary Planet*?

It is that which revolves round the sun only.

What is a *Secondary Planet*?

It is that which revolves round its primary, and with it round the sun.

What is the shape of these planets?

They are *Oblate Spheroids*, or flattened at the poles.

How are they known to be *Oblate Spheroids*?

By observations with a telescope.

What is the *Transit*?

It is the passage of a planet over the sun's disc.

What are *Asteroids*?

They are small bodies which revolve round the sun, and are much smaller than the planets.

What are *Comets*?

They are bodies revolving round the sun in very irregular orbits. Their number is not known.

How do you distinguish them?

By a fiery train on the side from the sun.

Of what is the solar system composed?

Of the *Sun, Planets, Asteroids, Comets, and Stars.*

SECTION II.

Of the Sun.

What is the *Sun*?

The sun is a luminous body, and is placed in the centre of the system, with all the planets revolving round it at unequal distances.

What does it afford to the other bodies?

It affords light, and perhaps heat and motion.

What do some suppose it to be?

They suppose it to be a large opaque body, surrounded by an extremely brilliant atmosphere, which has the power of diffusing particles of light throughout the system.

What is the *Velocity of Light*?

It moves 200,000 miles in a second.

What is the *Diameter* of the sun?

It is 883,246 miles.

How many revolutions has it?

Two—one on its axis, in 25 days 14 hours 8 minutes, and another in its orbit round a supposed centre.

How is its revolution on its axis determined?

From the spots on its surface, which appear first one side and then move over to the other side, and after being absent 12 days 7 hours, re-appear where they were first seen.

What is the *nature of these spots*?

There are various opinions of them. Dr. Herschel thinks they are caused by some interruption in the lucid atmosphere, which leaves the opaque body of the sun open to our view.

SECTION III.

Of the Planets.

How many *Primary Planets* are there?

~~Seven~~ 9 Mercury, Venus, the Earth, Mars, Jupiter, Saturn, and Herschel. URANUS + NEPTUNE

How many *Secondary Planets* are there?

Eighteen: the earth has one called the moon, Jupiter has four, Saturn seven, and Herschel six.

Of Mercury.

Which is the smallest of the planets?

Mercury is the smallest and nearest the sun.

What is its diameter?

It is 3200 miles.

What is its *Distance* from the sun?

It is 36,000,000 miles.

How many *revolutions* has Mercury?

It is not known for certainty to have more than one, and that is its revolution round the sun.

What is the *time* of this revolution?

It is 87 days 23 hours, or about 88 days.

What is said of the *light* and *heat* of Mercury?

They are about seven times greater than those of the earth.

SECTION IV.

Of Venus.

What is the *Diameter* of Venus?

It is 7,687 miles, being the smallest except Mercury and Mars.

What is its *distance* from the sun ?

It is 68,000,000 miles.

What is the time of its rotation on its axis ?

About twenty-three and a half hours.

What is the time of its annual revolution ?

About 224 days.

When is it called the morning star ?

When it is in the upper part of its orbit, and rises before the sun.

When is it called the evening star ?

When it passes round into the lower part of its orbit, and sets after the sun.

What are its light and heat ?

About double those of the earth.

How are the light and heat of any planet increased or diminished ?

According as it is nearer to the sun or farther from it ; Mercury will therefore have the greatest, and Herschel the least, of any of the planets.

How are the primary planets divided ?

Into *Inferior* and *Superior*.

Which are the *Inferior* ?

Mercury and Venus ; and the *Superior* are Mars, Jupiter, Saturn, and Herschel.

Why are they so divided ?

Mercury and Venus are called inferior because their orbits are less than that of the earth. The other four are called superior, because their orbits are greater than that of the earth.

Why do Mercury and Venus never have opposition ?

Because the earth cannot pass between them and the sun.

What peculiar variations have they ?

Inferior conjunction and superior conjunction.

Why can neither of the other four planets have inferior conjunction ?

Because neither of them can pass between the earth and sun.

How do you know Mercury and Venus to be opaque bodies?

Because when they pass between us and the sun, and the side not illuminated by the sun is presented to us, they appear dark, which would not be the case if they were luminous bodies.

SECTION V.

Of the Earth.

What is the earth?

It is a spherical body.

How is it known to be a spherical body?

First; such a figure is best adapted to motion. Second; navigators have sailed round it, which they could not do if it were not spherical. Third; its shadow on the moon in a lunar eclipse is spherical.

Is the earth a perfect sphere?

It is an oblate spheroid, or flattened at the poles.

What is its diameter?

It is 7,919 miles.*

Which is its greatest diameter?

The *Equatorial Diameter* is 25 miles greater than the *Polar Diameter*.*

What is its circumference?

About 24,877 miles.*

What is its *distance* from the sun?

About 96,000,000 miles.

How does it perform its *Diurnal Rotation*?

From west to east once in 24 hours.

What is the period of its *Annual Revolution*?

About 365 days 6 hours.

What is its *hourly motion* in its orbit?

It is 67,000 miles.

*These numbers are taken from the tables of Professor Adrain.

With what is the earth surrounded

With an invisible fluid called *air*.

What is the *Atmosphere*?

It consists of the air, with the vapours and other substances floating in it.

Is air a *simple* or *compound* fluid?

It is compound, and is composed of *oxygen* and *nitrogen*.

In what proportion?

About three fourths of nitrogen and one fourth of oxygen.

How do they differ?

Oxygen is heavier than nitrogen, and supports life, heat, and vegetation; nitrogen destroys them.

What is the weight of air?

It is 900 times lighter than water.

What other fluid contains oxygen?

Water is composed of 85 parts oxygen and 15 of hydrogen.

What is *Wind*?

A current of air put in motion.

What is the *Cause* of its motion?

When the air is rarefied by the heat of the sun it becomes light, and the heavier surrounding air rushing in produces wind.

Why then does the wind change its direction?

It is owing to the change of the sun's place, to the influence of mountains, valleys, oceans, &c.

How are the winds divided?

Into *Monsoons*, *Trade*, and *Variable Winds*.

Describe the *Monsoons*.

The monsoons, or shifting trade winds, are those which blow one half the year from the south-west, and the other half from the north-east.

Where do they prevail?

In the Indian Ocean.

Describe the *Trade Winds*.

They are those winds which always blow in the same direction ; on the north side of the equator from the east and north-east, on the south side from the east and south-east.

Where do they prevail ?

In the Atlantic and Pacific oceans, between the equator and 25 degrees of north and south latitude.

What are *Variable Winds* ?

Those which are continually changing from day to day, owing to the inequality of the earth's surface.

Where do they prevail ?

Beyond the 40th degree of latitude.

What are *land* and *sea Breezes* ?

Those which blow a certain number of hours from the land and then a certain number of hours from the sea. They prevail in the torrid zone.

What are *Vapours* ?

They are formed by watery particles separated from the land or water by the action of the sun ; being lighter than the air, they rise and float in it.

What are *Clouds* ?

They consist of vapours exhaled from the sea or land ; when these vapours rise to a height where their density is equal to the surrounding air, they unite and become heavier.

What is *Rain* ?

When clouds become so condensed and heavy that the air cannot support them, they descend in the form of rain.

Where does the most rain fall during the year ?

At the equator ; because the heat of the sun being there the greatest, produces the greatest exhalations.

What is *Snow* ?

It is composed of vapours frozen while small, and being but little heavier than the air, descend with a gentle motion to the earth.

What is *Hail* ?

It is composed of vapours condensed into drops, and by some sudden change in the atmosphere are frozen while falling.

What are *Fogs* and *Mist* ?

They are thin clouds resting on the surface of the earth.

Have the other planets an atmosphere ?

They are supposed to have.

SECTION VI.

Of Mars.

What is the *diameter* of Mars ?

It is 4189 miles, being the smallest except Mercury.

What is its *distance* from the sun ?

It is 144,000,000 miles.

What is the time of its *annual revolution* ?

One year and 321 days.

What is the time of its *diurnal rotation* ?

About $24\frac{1}{2}$ hours.

By what is Mars distinguished from the other planets ?

By a red fiery colour.

SECTION VII.

Of Jupiter.

What is the *diameter* of Jupiter ?

It is 89,170 miles, being the largest planet.

What is its *distance* from the sun ?

It is 491,700,000 miles.

In what time does it revolve on its *axis*?

About ten hours.

In what time does it revolve *round the sun*?

In eleven years 314 days.

By what is Jupiter distinguished?

By faint substances called belts, which surround it.

SECTION VIII.

Of Saturn.

What is the *Diameter* of Saturn?

It is 79,000 miles, being the largest except Jupiter.

What is its *Distance* from the sun?

It is 901,000,000 miles.

In what time does it revolve *on its axis*?

In about ten hours.

What is the time of its Annual Revolution?

It is 29 years and about a half.

By what is it distinguished?

By a large ring of solid matter which surrounds it.

SECTION IX.

Of Herschel.

When was this planet discovered?

In 1781, by Dr. Herschel.

What is its *Diameter*?

It is 35,000 miles.

What is its *Distance* from the sun?

It is 1800,000,000 miles.

In what time does it revolve *on its axis* ?

It is not discovered whether it revolves on its *axis*.

In what time does it revolve *round the sun* ?

In 83 years 150 days.

SECTION X.

Of the Moon.

What is the *Moon* ?

It is a satellite of the earth.

What is its *diameter* ?

It is 2180 miles.

What is its *distance* from the earth ?

About 240,000 miles.

In what time does it revolve around the earth ?

In about 27 1-2 days, about 2,300 miles an hour

In what time does it revolve on its axis ?

About 29 1-2 days.

When is it *New Moon* ?

When the moon is in conjunction, or between the earth and the sun, and the dark side is presented to us.

When is it *Full Moon* ?

When the moon is in opposition, or when the earth is between the sun and moon, and the illuminated side is presented to us.

Does the moon rise at the same hour every evening ?

It rises about an hour later every successive evening.

What is *Harvest Moon* ?

When the moon is full in September and October, it rises immediately after sunset for several days in

succession, and thus affords light for collecting the harvest, and is therefore called harvest moon.

SECTION XI

Of the Tides.

What is *Tide*?

It is the rising and falling of the waters in oceans and rivers.

How is it caused?

By the attraction of the sun and moon acting upon the water.

How are the tides divided?

1. Into *Flood* and *Ebb* tides.

2. Into *Spring* and *Neap* tides.

What is flood tide?

It is when the water is rising.

What is ebb tide?

It is when the water is falling.

How often do the flood and ebb tides happen?

Twice in each day.

What is spring tide?

It is the greatest flood and ebb tide.

When does it occur?

When the sun and moon are exactly on the same or opposite sides of the earth, and unite their attraction to raise water to its greatest height on opposite sides of the earth, and depress it to its lowest ebb 90 degrees distant from those points.

What is neap tide?

It is the least flood and ebb tide, and occurs when the sun and moon are in quadrature, and their attracting forces counteract each other.

How often do the spring and neap tides occur ?

Twice in each lunar month, at new and full moon.

How do the sun and moon differ in their attraction ?

The attraction of the moon upon the water is three times as great as that of the sun ; the tide will, therefore, be highest directly under the moon.

Why does the moon attract the water more than the sun does ?

Because it is so much nearer the earth than the sun is.

Why does the tide rise nearly an hour later each successive day ?

Because the moon revolves round the earth from west to east, and moves forward in its orbit nearly an hour in each day.

What have been discovered in the moon ?

Mountains, volcanoes, valleys, &c.

SECTION XII.

Of Eclipses.

What is an *Eclipse* ?

It is the interception of the rays of light by some opaque body passing between the sun and the eclipsed body.

How are the eclipses divided ?

1. Into *Solar* and *Lunar*.

2. Into *Total* and *Partial*.

What is a *Solar Eclipse* ?

It is an eclipse of the sun ; it happens only at new moon, and is caused by the moon passing between the earth and sun, and concealing the sun from our view.

What is a *Lunar Eclipse* ?

It is an eclipse of the moon ; it can happen only at full moon, and is caused by the earth passing between the sun and moon, and casting a shadow upon the moon's disc.

What is a *Total Eclipses* ?

It is when the whole of the disc of the sun or moon is concealed.

What is a *Partial Eclipse* ?

It is when only a part of the sun or moon is concealed.

What is the greatest number of eclipses that can happen in a year ?

Seven ; and in that case five will be solar and two lunar.

What is the least number that can happen in a year ?

Two ; and these must both be solar.

SECTION XIII.

Of the Fixed Stars.

What are *Fixed Stars* ?

They are those which appear to be always in the same situation with respect to each other.

What is the *Distance* of the nearest fixed star ?

It is supposed to be so far distant, that a ball going 500 miles an hour would not reach it in two millions of years.

What is the *Magnitude* of the fixed stars ?

They are supposed to be as large as the sun.

Are they luminous or opaque ?

They are supposed to be luminous, or to shine by their own light.

Why are they supposed to be luminous bodies ?

For two reasons ; 1. If they shine with reflected

light, they could not be seen at such an immense distance.

2. If they borrowed their light from any luminous body near them, that body would itself be visible.

What is a *Constellation*?

It is several stars included in a certain space.

What is the meaning of *Nebulous* or *Cloudy*?

It is a term applied to those clusters of stars which are so near together and so far distant that they appear like thin clouds.

What is the *Galaxy* or *Milky Way*?

It is a vast number of stars arranged so near to gether as to appear like clouds.

What is the number of constellations?

About ninety.

SECTION XIV.

A Table of the Magnitudes, Distances, and Revolutions of the planets, in round numbers.

Names.	Diameters.	Distance from the		Revolution		Revolution on its axis. Hours
		Sun.	Miles.	Y.	D.	
Sun,	883,000					
Mercury,	3,200		36,000,000		88	
Venus,	7,687		68,000,000		224	23½
Earth,	7,950		96,000,000		365	24
Mars,	4,189		144,000,000	1	321	24½
Jupiter,	89,170		491,700,000	11	314	10
Saturn,	79,000		901,000,000	29	178	10
Herschel,	35,000		1800,000,000	83	150	

How many *Asteroids* are there?

Four; all revolving round the sun in orbits between the orbits of Mars and Jupiter.

Table of the Asteroids.

Names.	Diameters. Miles.	Distance from the Sun.	Revolution round the Sun.	
			Y.	D.
Ceres,	1621,161	263,000,000	4	222
Pallas,	2092,110	266,000,000	4	222
Juno,	1425	253,000,000	4	130
Vesta,		225,000,000	3	240

What is the nature of the above planets and asteroids?

Mountains and valleys, &c. have been discovered on the Moon and Venus; hence we infer the same of the other planets, and that they have oceans, dry land, &c. and may be inhabited.

SECTION XV.

Of Maps.

What is a *Map*?

It is a delineation of the earth's surface on a plane.

How does a map differ from a globe?

In the same manner as a picture differs from a statue.

How do you know the directions on a map?

The upper end is north, the lower end south, the right hand east, and the left hand west.

How are the latitude and longitude found on a map?

The figures on the east and west side of a map show the latitude, and the figures on the north and south side show the longitude.

How are the several objects represented on a map?

Roads are represented by double lines.

Rivers, by black lines increasing towards the mouth of the rivers.

Lakes, by a dark colour the shape of the lake.

Sands and shallows by dots close together.

Bays and gulfs, by arms of the ocean or sea running up into the land.

SECTION XVI.

Of Globes.

What is a *Globe*?

It is a round body.

How many kinds of globes are there?

Two—*Terrestrial* and *Celestial*.

What does the terrestrial globe represent?

The figure of the earth, with its oceans, continents, rivers, kingdoms, &c., delineated on its surface.

What is represented on the celestial globe?

On its surface are delineated all the appearances of the heavens.

In viewing the representations on these globes, where is the eye supposed to be placed?

On the surface of the terrestrial globe, and at the centre of the celestial.

PART III.

PROBLEMS PERFORMED

BY THE

TERRESTRIAL GLOBE.

PROBLEM I.

To find the latitude of any given place.

Rule—Bring the place to the graduated side of the brazen meridian, and the degree of the meridian over the place is the latitude.

1. What is the latitude of London? Ans. Fifty-one and a half degrees north.

2. What is the latitude of St. Helena? About sixteen degrees south.

3. What places have no latitude?

Those directly under the equator.

4. Find all the places which have no latitude.

5. All places between the equator and south pole are in south latitude, and those between the equator and north pole are in north latitude.

6. Find the latitude of the following places.

Amsterdam, 52°	Dublin,	Norfolk,
Aleppo, 35°	Edinburgh,	Paris,
Athens, 37°	Fez,	Philadelphia,
Algiers, 31 1/2°	Halifax,	Prague,
Bengal,	Ispahan,	Quito,
Boston, 41°	Lima,	Rome,
Batavia,	Lisbon,	Stockholm,
Cape of Good Hope,	Madrid,	Teneriffe,
Cape Horn,	Madras,	Tripoli,
Cairo,	Moscow,	Washington,
Dantzic, 4° *	New York,	Vienna.

PROBLEM II.

To find the longitude of any given place.

Rule—Bring the place to the brazen meridian, and the degree of the equator under the meridian, is the longitude.

1. What is the longitude of Washington? About seventy-seven degrees west.

2. What is the longitude of Madras? Eighty degrees east.

3. What is the greatest longitude a place can have?

It is one hundred and eighty degrees.

4. How do you find all those places which have the greatest longitude?

Bring the one hundred and eightieth degree of the equator to the meridian, and all the places under the meridian have the greatest longitude.

5. Find the longitude of the following places.

Alexandria,	Gibraltar,	Portsmouth,
Archangel,	Havanna,	Quebec,
Aleppo,	Hamburgh,	Rhodes,
Albany,	Buenos Ayres,	Syracuse,
Baltimore,	Knoxville,	Rio Janeiro,
Berlin,	London,	Caraccas,
Constantinople,	Leghorn,	Sierra Leone,
Charleston,	Jerusalem,	Tunis,
Canton,	Montreal,	Tyre,
Calcutta,	New Orleans,	Toulouse,
Cadiz,	Nankin,	Vesuvius,
Delhi,	Oporto,	Venice,
Dresden,	Pekin,	Warsaw,
Damascus,	Petersburgh,	Washington.

PROBLEM III.

To find any place whose latitude and longitude are given.

Rule.—Bring the longitude of the place to the brazen meridian, and under the given latitude will be the place required.

1. What is the place whose east longitude is thirty degrees, and its north latitude thirty-one degrees? Ans. Alexandria.

2. What is the place in about six degrees west longitude, and sixteen degrees south latitude? Ans. St. Helena.

3. Find those places which have the following latitudes and longitudes.

Latitude.	Longitude
56 deg. South,	67 deg. West,
40 North,	116 East,
43 North,	79 West,
52 North,	5 East,
31 N.	30 E.
52½ N.	13 E.
30 N.	31 E.
34 S.	18 E.
49 N.	2 E.
42½ N.	71 W.
5 N.	52 W.
41 N.	29 E.
51½ N.	E.
12 S.	77 W.
33 N.	36 E.
30 N.	90 W

Note.—The degrees without the minutes are given, as being sufficiently accurate for all operations on the globe.

PROBLEM IV.

To find all those places that are in the same latitude or longitude of any given place.

Rule—Bring the given place to the brazen meridian; then all the places under the meridian are in the same longitude; turn the globe round, and all the places that pass under the latitude of the place are in the same latitude.

1. What places have nearly the same longitude as New York?

Ans. Montreal, St. Martha, Conception, &c.

2. What places have the latitude of New York?

Ans. Naples, Madrid, Pekin, &c.

3. What places have the same longitude as the following places?

Paris,	Boston,	Cape de Verd,
Archangel,	Mexico,	Cape Comorin,
Naples,	Gibraltar,	Bermudas.

4. What places have the latitude of the following places?

London,	Rome,	Lima,	Buenos Ayres.
Petersburgh,	Philadelphia,	Lisbon,	Halifax.

5. What places have noon at the same time with Baltimore?

This is the same as finding all places that have the same longitude with Baltimore.

6. What places have summer at the same time with Augusta in Georgia?

7. What places have winter at the same time with Buenos Ayres?

PROBLEM V.

To find the difference of Latitude between any two places.

Rule—Find the latitude of both places, and the number of degrees between them, reckoned on the brazen meridian, is the difference of latitude.

Note—If the places are on different sides of the equator, you add the two latitudes together : if on the same side of the equator, you subtract the less from the greater

1. What is the difference of latitude between London and Madras ? Ans. Thirty-eight degrees.

2. What is the difference of latitude between Boston and Cape Horn ? Ans. Ninety-seven and a half degrees.

3. What is the difference in latitude between Copenhagen and Gibraltar. 26

London and Cape of Good Hope, 84 1/2

Bengal and St. Helena,

Madrid and Moscow, 13

New-Orleans and New-York, 5

Montreal and Charleston, 10

London and New-York, 11

Pekin and Lima, 52

Edinburgh and Baltimore, 1

Calcutta and Philadelphia, 18

Cape of Good Hope and Cape Horn,

Dublin and Boston,

Petersburgh and Vienna,

Goa and Rome,

Philadelphia and Jerusalem,

The Azores and Spitzbergen,

Falkland Islands and Newfoundland ? 21

PROBLEM VI.

To find the difference of Longitude between any two places.

Rule—Find the longitude of both places, and the number of degrees between them will be the difference of longitude.

Note—If both places are east or both west longitude, subtract the one from the other; if the one is east and the other west longitude, add them together.

1. What is the difference of longitude between London and Constantinople? Ans. Twenty-nine degrees.

2. What is the difference of longitude between Montreal and Lisbon? Ans. Sixty-four degrees.

3. What is the difference of longitude between Philadelphia and Constantinople? Ans. One hundred and four degrees.

4. What is the difference of longitude between
 Acapulco and Lisbon,
 Madrid and Philadelphia,
 Cadiz and Batavia,
 Paris and Pekin,
 Cape Horn and Botany Bay,
 Cape Cod and Venice,
 Havana and Algiers,
 New-York and Canton?

5. If the sum of the longitudes exceed one hundred and eighty, subtract it from three hundred and sixty; the remainder will be the difference of longitude; as,

Acapulco	101° West,
Pekin	116° East,

217—143° diff. of longitude.

PROBLEM VII.

The hour of the day at any place being given, to find what o'clock it is at any other place.

Rule—Bring the place, where the hour is given, to the brazen meridian ; set the index to the given hour, then turn the globe till the proposed place comes under the meridian ; the index will point to the hour required.

Note—1. If the place required be to the east of the given place, it is later ; if to the west, it is earlier.

Note—2. If the place required be east of the given place, turn the globe westward : if to the west, turn the globe eastward.

1. When it is twelve o'clock at noon in London, what is the time at Mauritius and Philadelphia ?

Ans. Four P. M. at Mauritius, and seven A. M. at Philadelphia.

2. When it is 8 o'clock A. M. at Boston, what is the time at Acapulco and Cape Farewell ?

Ans. Six A. M. at Acapulco, and ten A. M. at Cape Farewell.

3. When it is midnight at New-York, what o'clock is it at

Paris,	Canton,	New-Orleans,
Rome,	Calcutta,	Rio Janeiro,
Petersburgh,	Cairo,	Ascension Island ?

4. When it is noon at Lisbon, what is the hour at

Quebec,	Jerusalem,	St. Helena,
Mexico,	Cape Comorin,	Botany Bay,
Cape Horn,	Pekin,	Athens,
Bermudas,	Babelmandel,	Tripoli ?

PROBLÉM VIII.

The hour of the day being given at any place, to find all the places on the globe where it is any other given hour.

Rule—Bring the place to the brazen meridian, and set the hour of the index at that place ; turn the globe till the index points to the other given hour, then all the places under the brazen meridian are the places required.

1. When it is twelve at noon at London, at what places is it eight A. M. ?

Ans. Cape Canso, Martinico, Trinidad, &c.

2. When it is 2 P. M. in London, where is it half past five P. M. ?

Ans. Caspian Sea, Socotra, Madagascar, &c.

3. When it is five A. M. at Madrid, where is it noon ?

4. When it is noon at New-York, where is it five P. M. ?

5. When it is ten A. M. at New-York, where is it noon ?

6. When it is noon at Paris, where is it midnight ?

7. Does the sun rise first upon Cape Farewell or New-Orleans ?

8. Does the sun set soonest at the Bermuda Islands, or the Gulf of California ?

9. What places have six o'clock A. M. when it is noon at the Falkland Islands ?

10. When it is noon at Lisbon, at what place is it eight o'clock in the afternoon, and at what places is it six o'clock in the forenoon ?

PROBLEM IX.

To find the Antœci of any place.

Rule—Bring the given place to the brazen meridian, and find its latitude ; then in the same degree of latitude, on the other side of the equator, will be the Antœci.

1. What is the Antœci of the Bermudas ?

Ans. Near the Cordova in Paraguay.

2. What is the Antœci of New-York ?

Ans. Near the Island of Chiloe.

3. What is the Antœci of Madagascar ?

Ans. Arabia.

4. Required the Antœci of

C. of Good Hope, Isthmus of Suez, Chesapeake Bay,
Cape Horn, Labrador, Jeddo.

PROBLEM X.

To find the Periœci of any place.

Rule—Bring the given place to the brass meridian, and set the index to twelve ; then turn the globe till the index comes to the other twelve, and under the latitude of the given place will be the Periœci.

1. What is the Periœci of the Gulf of Mexico ?

Ans. The Bay of Bengal.

2. What is the Periœci of the United States ?

Ans. China.

3. What is the Periœci of England ?

Ans. Near the Fox Islands.

4. What is the Periœci of the following places ?

Lake Superior,	Black sea,	Chili,
Baltimore,	Gibraltar,	Ceylon.

PROBLEM XI.

To find the Antipodes of any place.

Rule—Bring the given place to the Meridian, and find its latitude; set the index to twelve, and turn the globe till the index points to the other twelve; then the same degree of latitude on the other side of the equator shows the Antipodes, thus:

1. What is the Antipodes of London?

Ans. The south part of New Zealand.

2. What is the Antipodes of the Bermudas?

Ans. South-west part of New Holland.

3. What is the Antipodes of the Society Islands?

Ans. The Red Sea.

4. What is the Antipodes of

Cuba,	Caspian Sea,	Spain,
Terra del Fuego,	Egypt,	Persia?

PROBLEM XII.

To find the distance in miles between any two places on the globe.

Rule—Lay the quadrant of altitude over both places, and it will show the number of degrees, which multiply by sixty-nine and a half, and it will give the distance in miles.

1. What is the distance between London and Jamaica?

Ans. Sixty-seven and a half degrees, or four thousand six hundred and ninety-one miles.

2. What is the distance between New-York and Paris?

3. What is the distance between Baltimore and London?

4. What is the distance between

Cadiz and Petersburg,	Washington and Madrid,
Capes Horn and Good Hope,	Philadelphia and Venice,
New-York and London,	Cuba and Cyprus,
Charleston and Fez,	London and Bombay?

PROBLEM XIII.

The day of the month being given, to find the Sun's place or longitude in the Ecliptic, and its declination.

Rule—Look for the given day in the circle of months on the horizon, and opposite to it, in the circle of signs, are the sign and degree the sun is in on that day. Find the same sign and degree in the ecliptic, and it will be the sun's place or longitude; bring this place to the meridian, and you will have the declination.

1. What is the sun's longitude and declination on the 22d day of February?

Ans. Its longitude is three hundred and thirty-seven and a half degrees, or four and a half degrees, in Pisces; its declination is ten degrees south.

2. What is the sun's longitude and declination on the 15th of April?

Ans. Its longitude is twenty-five and a half degrees in Aries; its declination ten degrees north.

3. When does the sun enter each of the signs?

This question is answered in Part I. Sec. IV.

4. What is the sun's declination on the 21st of June?

5. What is the sun's place and declination on the 22d of December?

6. What is the sun's place in the ecliptic, and its declination, on each of the following days?

March	30th,	September	16th,
April	4th,	October	5th,
May	12th,	November	2d,
June	9th,	December	29th,
July	13th,	January	7th,
August	8th,	February	18th.

PROBLEM XIV.

To rectify the globe for the Latitude, Zenith, and Sun's place on any day.

1. **FOR THE LATITUDE.** Elevate the pole till the horizon cut the brass meridian in the degree corresponding to the latitude of the place.

2. The given place is then in the zenith.

3. Then (by Problem XIII.) find the sun's place for the given day, bring it to the meridian, and set the index to twelve.

Note—If the place be in north latitude, elevate the north pole, if in south latitude, elevate the south pole.

1. Rectify the globe for the latitude of London on the tenth of May.

In this case elevate the north pole fifty-one and a half degrees, then London will be in the zenith; over it screw the quadrant of altitude; the tenth of May on the horizon answers to the twentieth degree of Taurus, which find on the ecliptic, and bring it to the meridian, and set the index to twelve. This is the position of the globe as it appears to the inhabitants on the tenth of May.

2. Rectify the globe for

New-York,	12th January.
Boston,	6th February.
Constantinople,	9th March.
Petersburgh,	10th April.
Madrid,	16th September.
Cape Horn,	15th November.
St. Jago, (Chili)	14th December.
Gallipagos,	19th October.

PROBLEM XV.

The month and day of the month being given, to find all those places on the globe which will have a Vertical Sun on that day.

Rule—Find the sun's place on the ecliptic, (Prob. XIII.) and bring it to the meridian ; turn the globe round, and all the places that pass under that degree of the meridian, have a vertical sun on that day.

1. Find all the places which have a vertical sun on the twenty-second of February :

Ans. Peru, Amazonia, Angola, New Guinea, Queen Charlotte's Islands, &c.

2. What places have a vertical sun on the ninth of May ?

3. What places will have a vertical sun on the

21st of March,	23d of Sept.
21st of June,	22d of Dec ?

Note—Where the sun is vertical, the rains are almost continual, and cause the large rivers to rise.

4. What large rivers will be affected by a vertical sun on the first of June ?

5. What large rivers will be affected by a vertical sun on the first of March ?

6. At what places will the rainy season commence on the twentieth of April ?

7. What places will have a rainy season on the twentieth of October ?

8. What seas will have a vertical sun on the ninth of May ?

PROBLEM XVI.

To find at what hour the sun rises and sets at any place, and day in the year, and length of the day and night at that place.

Rule—1. Rectify the globe (by Problem XIV.) for the latitude of the place ; find the sun's place in the ecliptic (by Problem XIII.) and bring it to the meridian, and set the index to twelve ; bring the sun's place to the eastern edge of the horizon, and the index will show the hour of rising ; bring it to the western edge of the horizon, and the index will show the hour of setting.

2. Double the time of sun rising, and it will give the length of the night ; double the hour of sun setting and it will give the length of the day.

1. What time does the sun rise and set at New-York on the tenth of May, and what is the length of the day and night ?

Ans. It rises fifty-six minutes past four ; sets four minutes after seven ; length of the night nine hours fifty-two minutes ; of the day fourteen hours eight minutes.

2. What is the time of sun rising and sun setting, and the length of the day and night, at each of the following places, on the day mentioned ?

Washington City,	4th of May.
Constantinople,	14th of June.
London,	15th of July.
Rio Janeiro,	8th of September.
Cape Horn,	1st of December.
Rome,	5th of January.
Naples,	9th of October.
Canton,	8th of August.
Boston,	7th of November.

PROBLEM XVII.

To find the length of the longest and shortest days and nights in any part of the world. (See Part I. Sec. IV.)

Rule—1. If the place be in the northern hemisphere, rectify the globe for the latitude of the place, bring the first degree of Cancer to the meridian, and proceed as in the last problem.

2. If the place be in the southern hemisphere, bring the first degree of Capricorn to the meridian, and proceed as before.

1. What is the length of the longest day and shortest night at New York?

Ans. Longest day fourteen hours and fifty-six minutes, shortest night nine hours and four minutes.

Note—The shortest night of any place is equal to its shortest day, when the sun is on the other side of the equator, and its longest day to its longest night.

2. What is the length of the longest day and shortest night at each of the following places :

Boston,	London,	River Zaire,
Philadelphia,	Iceland,	Botany Bay,
Mexico,	Cape Verd,	Madras,
Halifax,	Suez,	Mouth of Colum-
Quebec,	Bombay,	bia River,
Argusta,	Canton,	Hudson's Bay,
New Orleans,	Madagascar,	Dardanelles,
Quito,	Abo,	Azores,
Chiloe,	Berlin,	Isles of Georgia?

The shortest day and longest night are shown by the above note.

PROBLEM XVIII.

The month, and day of the month being given, to find those places where the sun does not set, and where it does not rise on the given day. (See Part I. Sect. IV.)

Rule—Find the sun's declination (by Prob. XIII.) elevate the pole for the declination, in the same manner as for the latitude ; turn the globe on its axis, and on the places round the pole above the horizon the sun does not set ; and on the places round the other pole below the horizon, the sun does not rise on that day.

1. How much of the south frigid zone is darkened, and how much of the north frigid zone is enlightened on the twentieth of May ?

Ans. Twenty degrees round each pole.

2. On which pole does the sun rise on November the sixth ?

3. Which frigid zone and how much of it has constant day on August fourth ?

4. How much of the south frigid zone has constant day on the following days :

October 1st,	January 9th,
October 20th,	Feb. 10th,
Nov. 19th,	Feb. 20th,
Dec. 22d,	March 1st ?

5. What days in the year does the sun shine equally on both poles ?

PART IV.

PROBLEMS PERFORMED

BY THE

CELESTIAL GLOBE.

It may be proper here to repeat the following definitions :

1. *Latitude* on the celestial globe is reckoned from the ecliptic, north and south.

2. *Longitude* is reckoned on the ecliptic, from the first point of Aries round the globe.

3. *Declination* is reckoned from the equinoctial north and south.

4. *Right Ascension* is reckoned on the equinoctial from the first point in Aries round the globe.

In order that the student may be able to find the several stars mentioned in the following problems, I have thought proper to subjoin a list of the constellations, with the principal fixed stars in each.

1. *Constellations in the Zodiac.*

Names.	Principal Stars in each.
1. ♈ Aries	<i>Arietis.</i>
2. ♉ Taurus.	<i>Aldebaran, Pleiades, Hyades.</i>
3. ♊ Gemini.	<i>Castor and Pollux.</i>
4. ♋ Cancer.	<i>Acubens.</i>
5. ♌ Leo.	<i>Regulus and Deneb.</i>
6. ♍ Virgo.	<i>Spica Virginis & Vindematrix.</i>
7. ♎ Libra.	<i>Zubenelg & Zebenesh.</i>

- | | | |
|-------|--------------|-----------------|
| 8. ♏ | Scorpio. | <i>Antares.</i> |
| 9. ♐ | Sagittarius. | |
| 10. ♐ | Capricornus. | <i>Capella.</i> |
| 11. ♒ | Aquarius. | <i>Scheat.</i> |
| 12. ♓ | Pisces. | |

2. Constellations north of the Zodiac.

- | | |
|--|---|
| 1. Ursa minor, the little bear. | <i>Abruccabur.</i> |
| 2. Ursa major, the great bear. | <i>Alioth.</i> |
| 3. Draco, the dragon. | <i>Rastaben.</i> |
| 4. Cepheus. | <i>Alderamin.</i> |
| 5. Cassiopeia. | <i>Schedar.</i> |
| 6. Camelopardalus. | |
| 7. Auriga, the charioteer. | <i>Capella.</i> |
| 8. The Lynx. | |
| 9. Leo minor, the little lion. | |
| 10. Canes Venatici, the grey-hounds. | <i>Cor. Caroli.</i> |
| 11. Coma Berenices, Berenice's hair. | |
| 12. Bootes. | <i>Arsturus Mirach.</i> |
| 13. Corona Borealis, northern crown. | <i>Alphecca.</i> |
| 14. Hercules. | <i>Ras Algethi.</i> |
| 15. Lyra, the harp. | <i>Vega, Lyra.</i> |
| 16. Cygnus, the swan. | <i>Deneb, Albirco.</i> |
| 17. Vulpecula et Anser, the fox and the goose. | |
| 18. Sagitta, the arrow. | |
| 19. Delphin, the dolphin. | |
| 20. Equuleus, the little horse. | |
| 21. Pegasus, the flying horse. | <i>Markab Sheat.</i>
<i>Algenib.</i> |
| 22. Lacerta, the lizard. | |
| 23. Andromeda. | <i>Mirach Almaach.</i> |
| 24. Triangulum, the triangle. | |

25. *Musca Borealis*, the northern fly.

26. *Perseus et caput Medusæ*, head of Medusa. *Angol.*

27. *Serpens*, the serpent.

28. *Ophincus vel serpentarius*. *Ras. Alhagus.*

29. *Taurus Poniatouski*, Poniatouski's bull.

30. *Aquila*, the eagle. *Atair.*

3. *Southern Constellations.*

Names.	Principal Stars.
1. <i>Cetus</i> , the whale.	<i>Menkar.</i>
2. <i>Eridanus</i> , the river Po.	<i>Achernar.</i>
3. <i>Orion</i> .	<i>Betelgeuse, Rigel.</i>
4. <i>Monoceros</i> , the unicorn.	
5. <i>Canis minor</i> , the little dog.	<i>Procyon.</i>
6. <i>Sextans</i> , the sextant.	
7. <i>Crater et Hydra</i> , the cup and Hydra.	
8. <i>Corvus</i> , the crow	<i>Algorab.</i>
9. <i>Centarus</i> , the centaur.	<i>A bright star.</i>
10. <i>Lupus</i> , the wolf.	
11. <i>Norma</i> , the rule.	
12. <i>Circinus</i> , the compasses.	
13. <i>Triangulum australe</i> , the southern triangle.	
14. <i>Ara</i> , the altar.	
15. <i>Telescopium</i> , the telescope.	
16. <i>Corona Australis</i> , the south crown.	
17. <i>Indus</i> , the Indian.	
18. <i>Microscopium</i> , the microscope.	
19. <i>Piscis Australis</i> , southern fish.	<i>Fomalhaut.</i>
20. <i>Grus</i> , the crane.	

21. Toucana, the American goose.
 22. Phenix.
 23. Apparatus sculptoris, the sculptor's apparatus.
 24. Fornax, the furnace.
 25. Horologium, the clock.
 26. Cella sculptoria, the engraver's tools.
 27. Lepus, the hare.
 28. Canis Major, great dog. *Sirius.*
 29. Columba, the dove.
 30. Equuleus pictoreus.
 31. Argo navis, the ship Argo. *Canopus.*
 32. Pixis nautica, the mariner's compass.
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The following table shows in what part of each constellation the principal stars are placed.

- Aldebaran, in the south eye of Taurus.
- Acubens, in the claw of Cancer.
- Antares, in the heart of Scorpio.
- Abruccabar, the pole star in the tail of the little Bear.
- Alioth, the first star in the tail of the great Bear.
- Arcturus, in Bootes.
- Alphecca, the bright star in the northern crown.
- Almaach, in the foot of Andromeda.
- Algol, in the head of Medusa.
- Atair, the bright star in the Eagle.
- Achernar, in the river Eridanus.
- Betelgeux, in the east shoulder of Orion.
- Bellatrix, in the west shoulder of Orion.
- Castor and Pollux, in the head of Gemini.
- Capella, the bright star in Capricorn.
- Cor. Caroli, the double star in the greyhounds.

Canopus, the bright star in Argo.
 Deneb, in the tail of the swan.
 Fomalhaut, bright star in the southern fish.
 Hyades, in Taurus.
 Mirach, in the thigh of Bootes.
 Markab, in the wing of Pegasus.
 Mirach, in the girdle of Andromeda.
 Menkar, in the jaw of the whale.
 Pleiades, the brightest star in Taurus.
 Procyon, bright star in the little Dog.
 Regulus, in the heart of Leo.
 Rastaben, in the head of the dragon.
 Ras. Algithi, in the head of Hercules.
 Ras. Alhagus, in the head of Ophincus.
 Rigil, in the foot of Orion.
 Scheat, the bright star in Aquarius.
 Schedar, in the breast of Cassiopeia.
 Sheat, in the thigh of Pegasus.
 Sirius, bright star in the great Dog.
 Virgin's spike, in the sheaf of Virgo.
 Vega, the bright star in the Harp.
 Zubenelg, in the north scale of Libra.
 Zubenesh, in the south scale of Libra

PROBLEM I.

To find the right ascension of the sun or a star.

Rule—Bring the sun's place in the ecliptic* or the star, to the brass meridian, then the degrees of the equinoctial under the meridian, reckoning from Aries eastward, is the right ascension.

1. What is the sun's right ascension on the 19th of April? Ans. Twenty-seven and a half degrees.

2. What is the sun's right ascension on the 1st Dec.?
Ans. Two hundred and forty-seven degrees fifty minutes.

3. What is the sun's right ascension on—

Nov. 6th,	May 7th,
March 4th,	August 10th,
April 20th,	Sept. 14th,
June 16th,	Oct. 23d,
July 29th,	Dec. 10th?

4. What is the right ascension of Aldebaran?

Ans. Sixty-six degrees six minutes.

5. What is the right ascension of—

Alioth,	Fomalhaut,	Rastaben,
Arcturus,	Hyades,	Rigel,
Achernar,	Menkar,	Sirius,
Bellatrix,	Pleiades,	Antares,
Castor,	Procyon,	Pollux,
Algol,	Regulus,	Acubens?

NOTE—The preceding stars, and their places in the constellations, may all be found in the preceding table.

* By prob. 13. part 3.

PROBLEM II.

To find the declination of the sun or a star.

Rule—Bring the sun's place to the ecliptic,* or the star to the brazen meridian, and the degree of the meridian over that place will be the declination.

1. What is the declination of the sun, April 19th ?

Ans. Eleven degrees, nineteen minutes north.

2. What is the sun's declination,

January 18th, April 12th,

February 12th, May 23d,

March 2d, June 21st ?

3. What is the declination of Aldebaran ?

Ans. Sixteen degrees, six minutes.

4. What is the declination of—

Atair,	Arcturus,	Regulus,
Algenib,	Procyon,	Regel ?

PROBLEM III.

The latitude of the place, the day and hour being given, to place the globe so as to represent the appearance of the heavens at that time at the place ; and to point out the situation of the several stars.

Rule—Elevate the pole for the latitude of the place ; find the sun's place in the ecliptic, and bring it to the meridian, and set the index to 12 ; if the time be afternoon, turn the globe westward, if in the forenoon turn the globe eastward till the index points to the given hour. The surface of the globe then represents the appearance of the heavens at that place.

1. Represent the appearance of the heavens for Jan. 13th, 4 o'clock A. M. and 8 o'clock P. M.

* By prob. 13. part 3.

PROBLEM IV.

To find the latitude or longitude of a given star.

Rule—Screw the quadrant on the pole of the ecliptic, bring the star to the meridian, and the degrees of the quadrant between the ecliptic and star show the latitude, and degree of the ecliptic under the graduated edge of the quadrant is the longitude.

1. What is the latitude and longitude of Arcturus?

Ans. Latitude thirty-one degrees north. Longitude two hundred and one degrees.

2. What are the latitudes and longitudes of
Fomalhaut, Canis Major,
Canis Minor, Regulus?

PROBLEM V.

The latitude or longitude of a heavenly body being given, to find its place on the globe.

Rule—Fix the quadrant as in the last problem, and place it on the given degree of longitude in the ecliptic; then seek the given latitude on the quadrant, and under that degree is the place sought.

1. What is the star whose longitude is two hundred and one degrees, and its latitude thirty-one degrees north?

Ans. Arcturus in Bootes.

2. What stars have the following longitudes and latitudes?

Longitudes.	Latitudes.
66½ degrees,	5½ degrees south,
299 degrees,	29 degrees north,
85 degrees,	16 degrees south.

ROBLEM VI.

The right ascension and declination of a heavenly body being given, to find its place on the globe.

Rule—Bring the given right ascension to the brass meridian, and under the given degree of declination on the meridian, is the place required.

1. What is the star, whose declination is thirty degrees forty minutes south, and right ascension three hundred and forty-one degrees thirty-eight minutes?

Ans. Fomalhaut in the southern fish.

2. What are the stars whose right ascensions and declinations are as follows:

Right ascension.

1838 54'

2778 32'

6*

66°

Declination.

698 59' south,

388 39' north.

161° 59' 40"

32°

10° 39'

QUESTIONS

IN

ASTRONOMY.

- WHAT is astronomy ?
 What is the solar system ?
 What does astronomy teach ?
 What is a planet ?
 Of what is the solar system composed ?
 What is the diameter of each of the primary planets ?
 What is the year of any planet ?
 What is tide ?
 What is an eclipse ?
 What is a great circle ?
 What is the axis of a heavenly body ?
 What is an orbit ?
 What are the polar circles ?
 What is longitude on the earth ?
 What is a primary planet ?
 What is a secondary planet ?
 How does a planet perform its diurnal rotation ?
 What is declination ?
 What is a meridian ?
 What is a hemisphere ?
 When does an eclipse of the moon happen ?
 When does an eclipse of the sun happen ?
 How are the secondary planets distributed ?
 What is the distance of each of the primary planets from the sun ?
 In what time does each of the planets revolve round the sun ?

- What is the rational horizon
 Describe the Ptolemaic and Tychonic systems.
 Describe the Copernican system.
 What is the number and names of the Asteroids?
 Where are their orbits?
 What is diurnal rotation?
 What is annual revolution?
 What is an angle?
 Describe the right, obtuse, and acute angles.
 What is a triangle?
 What is the disc of a heavenly body?
 What is a circle?
 How are eclipses divided?
 What is a digit?
 Describe the diameter and radius of a circle.
 What is a map?
 What is a globe?
 What is the solar eclipse?
 What is a lunar eclipse?
 How is the tide caused?
 How many hemispheres are there?
 How are the tides divided?
 What is flood tide? And ebb tide?
 What is a total eclipse?
 What is a spring tide? And neap tide?
 What are the fixed stars?
 Why are they supposed to be luminous bodies?
 What is a constellation? Their number?
 What is the galaxy?
 What is the nature of the planets and asteroids?
 What is the sensible horizon?
 How often do the spring and neap tides occur?
 How often do the flood and ebb tides happen?
 In what time does each of the primary planets revolve on its axis?
 How do the sun and moon differ in their attractions?
 How do the planets revolve round the sun?

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 What are the celestial poles
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 What is harvest moon? 34
 To what are small circles parallel?
 What is the diameter of the moon?
 What is quadrature? 34
 What is opposition?
 What are parallels of latitude?
 In what time does the moon revolve round the earth?
 How many kinds of conjunctions are there?
 What are parallels of declination?
 Describe inferior and superior conjunction. 24
 What are parallels of latitude on the celestial globe?
 What is the moon's distance from the earth?
 What is centripetal force?
 What is centrifugal force?
 How is the earth known to be a spherical body?
 What are concentric circles?
 What is the occultation of a heavenly body?
 What are cardinal points?
 How are the planets divided?
 What is hail?
 How are the heavenly bodies divided?
 What is the equator? Has it any other names?
 What are reckoned on it?
 What is a luminous body?
 What is an opaque body?
 What is the hour circle?
 Have the planets an atmosphere?
 What is wind? How is it caused?
 What is the shape of the planets?

What is air? Is it a simple fluid?

What is the sun? Its diameter?

What is the first meridian?

What is the brazen meridian?

How are the degrees numbered on it?

What does the sun afford to the other bodies?

What is the greatest longitude a place can have?

What is latitude? What is the greatest latitude?

What do some suppose the sun to be?

What is the earth's hourly motion in its orbit?

What are fogs and mist?

How is longitude reckoned on the celestial globe?

What is latitude in the heavens?

What is the greatest latitude of the sun, a planet, or a star?

What is the greatest declination of the sun, a planet, or a star?

What is the velocity of light?

What is geocentric latitude and longitude?

What is heliocentric latitude and longitude?

How do you know the directions on a map?

What does the terrestrial globe represent?

What is right ascension?

What is oblique ascension?

What is the transit?

What is a climate?

What is the zenith?

How many positions has the sphere?

Which planet is nearest the sun?

Which is the most distant from the sun?

What are comets? And how distinguished?

How many primary planets are there?

When is Venus the evening star?

When the morning star?

What is a right sphere? How represented?

What is the longest day and night at the poles?

What is an oblique sphere? How represented?

Which is the largest planet ?

Which is the smallest ?

What is a parallel sphere ?

What is said of the day and night when the sun is in the solstitial points ?

What is the ecliptic ? Of what is it the path ?

What is the equinoctial colure ?

What are the antipodes ?

How is the heat of any planet increased or diminished ?

What is snow ? What is hail ?

What are the equinoctial points ?

How is the ecliptic divided ?

Where does the most rain fall ? and why ?

Mention the names of the twelve signs, and the day on which the sun enters them.

What are clouds ? What are vapours ?

When is the sun in the equinoctial points ?

What is the solstitial colure ?

When is the sun in the solstitial points ?

How does a map differ from a globe ?

In viewing the representations on the globe, where is the eye supposed to be placed ?

What are the poles of the horizon ?

Describe the variable winds. Where do they prevail ?

What is the wooden horizon ?

What is a vertical or azimuth circle

What is the azimuth of a heavenly body ?

Why do the superior planets never have inferior conjunction ?

How do you find the latitude of any given place ?

What is the latitude of Newfoundland ?

How do you find the longitude of a given place ?

What is a prime vertical ?

How do you find all the places in the latitude and longitude of any given place ?

What is a zone ?

How many zones are there ?

How wide are the frigid zones ?

How do you find the antœci of any place ?

What is the diurnal arch ?

How wide are the temperate zones ?

How wide is the torrid zone ?

How do you find the antipodes ?

How do you find the pericœci of any place ?

Describe the north and south frigid zones.

What is the zenith distance ?

What countries are in the north temperate zone ?

What are the polar circles ?

What are the tropics ?

What countries are in the south temperate zone ?

What places are in the torrid zone ?

How do you find the latitude and longitude of a given star ?

How do you find the right ascension of the sun or of a star ?

What is twilight ?

What is the polar distance ?

When does a place have a vertical sun ?

When the day and hour are given at any place, how do you find what o'clock it is at any other place ?

What is the nocturnal arch ?

What places have a vertical sun ?

Through what points do the tropics pass ?

When is it the longest day in the southern hemisphere ?

When is it the longest day in the northern hemisphere ?

What causes the succession of day and night ?

Why does the moon rise an hour later on each successive evening ?

What is reflected light ?

What is the cause of twilight ?

For questions adapted to practice upon the globes, the student is referred to the examples under the problems.

THE END.





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